DOCUMENT RESUME

ED 452 803 IR 020 611

| | |
|---|---|
| AUTHOR | Walters, Deborah; Burhans, Debra; Kershner, Helene; Alphonce, Carl |
| TITLE | Early Followers versus Early Adopters: The Use of Technology as a Change Lever Leads to Increased Learning and Decreased Costs in a Computer Fluency Course. |
| PUB DATE | 2000-10-00 |
| NOTE | 12p.; In: EDUCAUSE 2000: Thinking IT Through. Proceedings and Post-Conference Materials (Nashville, TN, October 10-13, 2000); see IR 020 605. |
| AVAILABLE FROM | For full text: http://www.educause.edu/conference/e2000/proceedings.html. For full text: http://www.educause.edu/asp/doclib/abstract.asp?ID=EDU0004.html. |
| PUB TYPE | Reports - Descriptive (141) -- Speeches/Meeting Papers (150) |
| EDRS PRICE | MF01/PC01 Plus Postage. |
| DESCRIPTORS | Computer Assisted Instruction; *Computer Uses in Education; Cost Effectiveness; Course Content; *Curriculum Design; Educational Development; *Educational Technology; Higher Education; Technology Integration |
| IDENTIFIERS | State University of New York Buffalo; *Technology Implementation |

ABSTRACT

Many early adopters of educational technology report increased costs-both in technology and in faculty time. This research shows how early followers can decrease costs by using existing online supplementary materials and a redesigned course structure that increases face-to-face contact and provides multiple means for students to learn course concepts. The experience of a course team at the University of Buffalo in the redesign of a computer fluency course is related. Based on this experience, evidence of the following prerequisites for early followers' success is provided: (1) if the physical infrastructure necessary for the course does not already exist at an institution, then the cost of providing such infrastructure will reduce any cost savings; (2) it is important to have good technical support before embarking on an early follower project; (3) the existence of adequate course management software is necessary; and (4) the existence of course specific software is needed. This work can serve as a model for other early followers within the university, and can also serve as a model for faculty at other institutions who wish to be early followers and create pedagogical use of technology that is scalable. (Contains 11 references.) (AEF)

# Early Followers versus Early Adopters: The Use of Technology as a Change Lever Leads to Increased Learning and Decreased Costs in a Computer Fluency Course

*Deborah Walters, Debra Burhans, Helene Kershner and Carl Alphonce*
*Department of Computer Science and Engineering*
*University at Buffalo (SUNY)*
*Buffalo, NY*

***Abstract:***

Many early adopters of educational technology report increased costs – both in technology and in faculty time. This research shows how early followers can decrease costs by using existing on-line supplementary materials and a redesigned course structure that increases face-to-face contact and provides multiple means for students to learn course concepts.

# Early Followers versus Early Adopters: The Use of Technology as a Change Lever Leads to Increased Learning and Decreased Costs in a Computer Fluency Course

*Deborah Walters, Debra Burhans, Helene Kershner and Carl Alphonce*

### *Introduction:*

Early adopters of educational technology have found that most uses of technology to improve learning result in added costs both in terms of faculty time and in technology costs. For example, the development of the case-based ethics software at CMU [1] required a significant investment of faculty time to create a rich on-line environment. While many early adopters have willingly spent the many additional hours time required to develop and mount technology enhanced or on-line courses, this is not a model that scales for two reasons. First, while an early adopter may be willing to initially devote large amounts of time to their course, if the course continues to require significant additional effort, faculty members often find they are unable and/or unwilling to maintain the additional effort. Second, when other faculty members observe the amount of time invested by the early adopters they can become even less willing to engage in such activity themselves. This issue of additional time is especially problematic now when faculty members are seeing other increasing demands on their time.

Many early adopters have also found an increase in costs associated with the technology itself: hardware costs, maintenance costs, software costs, connectivity costs, etc. For example, the studio classrooms at RPI [2] and the Math Emporium at Virginia Tech [3] both required significant capital costs to build and equip. Synchronous video-conferencing style courses can be expensive in terms of building facilities and in terms of the recurring line charges. In addition, where students did not already have access to computers, the early adopters had to deal with the costs of providing such access. These cost increases are especially problematic, as the containment of rising costs is one of the top issues currently facing colleges and universities.

### *Technology as a Change Lever:*

Yet the increasing use of technology in higher education can provide a lever for change. As faculty members and administrators consider how best to take advantage of the new technologies, an opportunity is presented to reconsider how education is delivered and to develop a culture of considered and deliberate change.

The traditional responsibilities in higher education result in the faculty designing and delivering the curriculum, while the administrators are the ones who consider costs and resource management. Thus there is a disconnection between the design of the curriculum and the consideration of costs, which may result in the best decisions not being made. Technology can act a lever for change in overcoming this disconnection. When faculty members deliberate

upon the role of technology in education while bearing in mind the constraints of cost, the deep faculty pool of creativity and intelligence can result in new approaches to learning that are both pedagogically sound and have the potential to scale beyond the early adopters.

Technology can be a lever for change not only in the consideration of costs, but more importantly in the consideration of pedagogy. Nora Sabelli, Senior Project Director of NSF's Education and Human Resources program has called for more movement from passive to active learning, and has described the interaction between passive versus active learning and technology using the following diagram [4].

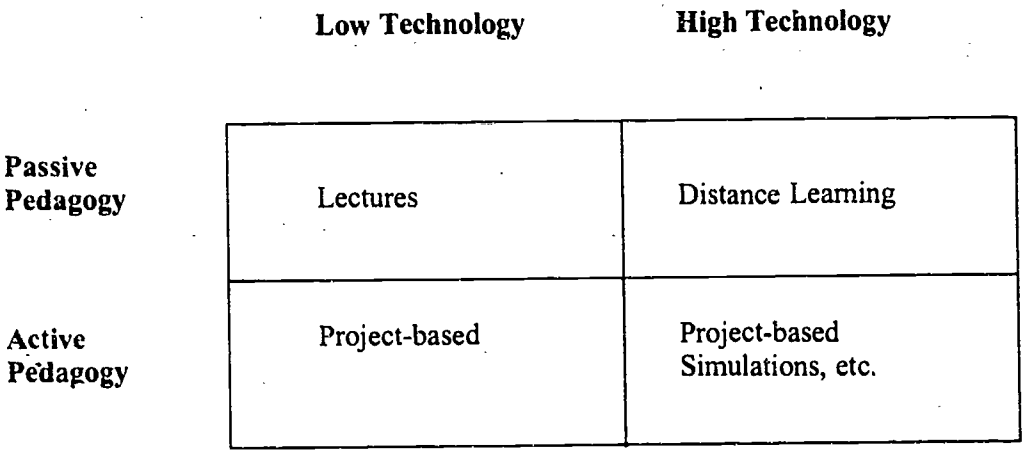


**Figure 1:** Interactions between Pedagogy and Technology

The goal for Sabelli is to see more movement from the upper left quadrant to the lower two quadrants. Some faculty members may be interested in incorporating technology into their courses, but may not be interested in contemplating the effects of different pedagogies. For those faculty members technology can be a change lever - thinking about and researching new uses of technology can motivate discussions and considerations of pedagogy. Thus the technology may act as a change lever for movement from the upper left to the lower right quadrant.

### *Early Followers versus Early Adopters:*

Early followers differ from the early adopters of educational technology in several ways. First, they do not have to create the majority of the on-line course materials for a course. They can utilize existing materials that are available either from the early adopter professors or from text-book publishers. Early followers argue that creating on-line course materials is akin to writing a textbook. Certainly not every professor writes their own textbook, and when a professor adopts a textbook he didn't write, he picks and chooses from among it's topics, provides additional course materials in areas he wishes to emphasize, and in general creates a course that bears his own personal imprinteur. Similarly not every professor will write her

own on-line course materials, and when using materials from other sources, she will selectively customize them to reflect her own particular approach to the subject matter.

Second, by using commercially available course management software, the early follower can avoid some of the costs encountered by the early adopters in the creation of components of such software. In some cases the institutions incur additional costs through the licensing of course management software and the maintenance and hardware costs of servers for its installation. A second option is to let the textbook publisher provide the course management software from a centrally maintained site, and then passing the cost onto the students as a part of their textbook purchase.

By using existing on-line course materials and commercially available course management systems, the early follower does not have to spend the large amounts of time in the creation of materials that the early adopter does – which can lead to a significant savings in faculty time. However, compared to not using technology at all, there is a significant faculty time investment in selecting and testing the on-line materials. Good technical support is also required to install and test the materials in the local setting.

A third difference is that the early follower is often in the situation where students already have access to computers and the internet. At some universities students are expected to either purchase their own computer or to otherwise find access to a machine [5,6]. At these and at other institutions there are also computer-equipped labs for student use on campus, as well as the connectivity required for Internet access. Thus the early follower is often in the situation where incorporating technology-based changes into their courses will not result in significant additional hardware, software, maintenance and connectivity costs. External forces are already causing institutions of higher education to provide the computing infrastructure – the early followers are simply utilizing that infrastructure in additional ways.

A final advantage for the early follower over the early adopter is that there is now more known about the potential pedagogical advantages and disadvantages of various types of usage of technology in higher education.

### *Pew Learning and Technology Program:*

Through a grant from the Pew Learning and Technology Program (PLTP) [7, 8] a faculty team at University of Buffalo was formed to restructure a large enrollment computer fluency course. The goal of the PLTP is to demonstrate how the use of technology can lead to an increase in student learning, while at the same time reducing costs. The program provides the grantees with a structured method for analyzing the full costs of a course. By applying the method to both a traditionally taught course and a restructured version of the course it is possible to determine what the added costs or the cost savings are for a contemplated change in course structure. One advantage of this methodology is that it enables faculty to quantitatively measure the cost consequences of a course restructuring. But the main advantage comes from simply engaging faculty in the consideration of costs - the various tradeoffs between ideal, yet

unaffordable instructional methods and more cost effective, yet pedagogically sound instruction. Through such discussions, creative solutions to the tradeoffs can arise that maybe superior to even the high cost methods previously utilized.

### *Redesign of a Computer Fluency Course:*

The faculty team redesigned a computer fluency course for non-majors. The traditional course involved three hours of 200 seat lectures taught by faculty and two hours of thirty seat labs taught by graduate teaching assistants per week. The first step in the redesign process was to determine the learning goals for the course. The team had been following the work of the committee charged by the National Research Council to answer the question, "What should everyone know about computers and information technology?" Their report, "Be FIT: Fluency in Information Technology" [9], identified three classes of learning goals: concepts, skills and capabilities (or critical thinking). The report argued that computer literacy courses that only teach skills could be improved by including concepts and critical thinking as well. For each of the three areas, the report specified ten specific learning goals. Since the UB course had already included all three areas, the team chose to adopt almost all of the thirty learning goals specified in the Be FIT report.

The next step in the redesign process was to determine which aspects of a computer fluency course were amenable to improvement through increased use of technology and which aspects are best preserved in their more traditional form. This process lead to the following general goals for the redesigned course:

- To increase learning, especially active learning;
- To provide multiple means for students to learn the course concepts and skills;
- To preserve or even increase the face-to-face contact; and,
- To decrease costs.

The course team did not want to take the route of some early adopters and create an on-line course, as there are advantages to face-to-face interactions, especially when learning to use computer technology. In addition, it was decided that for some course material there are advantages in continuing to use large section lectures. Thus the on-line materials were viewed as a useful supplement to the more traditional components of the course.

Despite what appeared initially to be conflicting goals, the team used these goals to constrain their thinking about the redesigned structure of the course. By adding in considerations of how technology could be used to achieve the goals, the team found they had to create new ideas for the course structure. This analysis lead to the rethinking of the basic pedagogy of the course and the creation of novel solutions to satisfy the constraints.

Increases in learning were predicted to come from an increase in lab hours. The additional lab hours are made possible both through the use of undergraduate learning assistants, on-line grading and through decreasing the lecture hours. The latter is possible because the web-based and CD-ROM supplemental materials will provide students with multiple means to learning the conceptual material. In addition, there is evidence that for some topics students learn more

from the experiential, active learning during labs than from lectures in computer fluency courses [10]. For example, watching a professor demonstrate how to use a spreadsheet during a lecture is less effective than participating in an active learning exercise in a lab. But not all lectures were replaced, as they can be good for presenting man aspects of the conceptual material. Short video clips of portions of the lecture where hard to grasp concepts are presented will be placed on the course web-site to allow students to watch and listen to the presentation multiple times. In addition, short video clips on topics like setting up an email account at the university and other site specific items will be created.

The use of on-line diagnostic quizzes is also expected to lead to increased student learning. On-line tests in which all but the essay questions are graded by the computer may also lead to better learning, as the students will be provided with immediate feedback at the end of each test on their performance. This on-line testing, grading and automatic grade reporting will also save faculty time. In addition, by using the automatic randomization and selection of test questions, the faculty time spent in test preparation can be reduced.

Since this particular course is designed for students who are not comfortable with computer technology, it was determined that it is not possible to replace the bulk of the lecture/lab course with on-line instruction. In fact, for the student population in the course, it was felt that more one-on-one, face-to-face learning opportunities were required to provide the students with a solid foundation in computer fluency. The challenge was how to provide this while at the same time reducing costs. One part of the solution involves using on-line testing and a commercial course management system, as this allows undergraduate student learning assistants (ULA's) to be used in the place of graduate student teaching assistants (GTA's). Without this use of technology, it is not possible to use ULA's, as our university prevents ULA's from doing grading and grade recording. There are several pedagogical advantages to using the ULA's. First, the GTA's were typically computer science and engineering graduate students during their first months of living in the US, and were unfamiliar with US undergraduate education and culture. Thus there was often a mismatch between the undergraduates, many of who were computer-phobic, and the graduate students who had been computer savvy for years. ULA's on the other hand tend to be undergraduates from disciplines other than computer science and engineering who have more recently learned the basic concepts of computing and thus are better able to understand the common misunderstandings of the novice users. In addition, since the GTA's are more than twice the cost of the ULA's, it is possible to double the number of assistants and still maintain a cost reduction. This means that more students can receive face-to-face help at once.

To help reduce the development and maintenance costs the faculty team decided to use existing on-line active learning materials that are available from either textbook publishers or from faculty at other institutions. In addition, a commercially available course management system will be used rather than having the faculty write their own portions of such software. Thus by being early followers, rather than early adopters, the team expects to see time (and thus cost) savings that are not possible for early adopters who must create much of their own courseware.

During the first year of the restructuring project the faculty team is in the process of reviewing and selecting commercially available on-line and CD-ROM materials, and in collecting base-line data from the course that is still being taught in its traditional form. A pilot version of the restructured course will be taught in the summer, and full-scale implementation will begin in the second year of the project. The success of the restructured course will be judged by comparing student learning, changes in student attitudes towards computer usage and costs in the new course against the same base-line data collected from the traditional course.

### *Outcomes:*

One outcome of the project has been the plan for the restructuring of a specific course. In terms of cost, the plan indicates that the per student cost of the course will drop from $248 to $114 if the enrollment is held constant. If the enrollment grows from the current 490 to the maximum possible enrollment of 665 students per semester, the per student cost would drop to $99. Thus significant cost saving are predicted. Some of the cost savings will be seen by the institution as actual cost savings – fewer dollars expended. Another part of the savings will be seen by the faculty members in terms of their time commitment as we predict that less time will be required in lecture preparation, lecture presentation, test preparation, test grading and grade reporting. Thus faculty members will be spending less time on some of the management aspects of the course, allowing them to spend more time on student interactions or other activities such as computer science education research. While the faculty team believes that learning will also improve, the results of the testing of this hypothesis will not be available for another year.

A second outcome is that the faculty team is now well versed in considering the costs of instruction when designing courses. While one benefit of this is the redesign of the specific course, a major benefit is that the faculty members can now apply what they have learned to the redesign of other courses.

## *What is Necessary for Success for Early Followers?*

The experience of the course team in the redesign of a computer fluency course provides evidence of the following four prerequisites for success for early followers.

1. Physical infrastructure
   If the physical infrastructure necessary for the course does not already exist at an institution, then the cost of providing such infrastructure will reduce any cost savings. However, many institutions have found it necessary to provide the computer labs, networking and software even when they are not used directly in technology enhanced courses. This infrastructure is becoming a normal cost of business for higher education. The majority of today's students have their own computers and expect their college or university to provide the necessary infrastructure for their effective use. The creation of technology enhanced courses can provide another means of capitalizing on the existing

infrastructure, and the potential cost savings from such courses may be used to help offset the operating costs of the physical infrastructure.

2. Technical support infrastructure
   The UB course team found that they spent more time than expected dealing with installation of new software in the lab. An analysis of the additional time found that faculty members were spending significant time in trouble shooting problems that arose when using the software available from publishers and the course management software. At the time it was not clear whether the problems were with the software, or with the installation of the software in the laboratory server environment. After receiving assistance from well-trained technical support staff it was determined that most of the problems were due to inappropriate installation. Another example where the additional faculty time required could have been avoided was in the creation of short video clips. Again, while the appropriate expertise exists on our campus it took the course team several false starts before locating the expertise. This underscores the need for good technical support before embarking on an early follower project. In addition this experience shows the importance of having a clearinghouse on campus for non-standard course-related technology requests where faculty can be pointed to the appropriate technical support. Fortunately UB now has an Educational Technology Center that will soon be able to fulfill that role.

3. Adequate course management software
   A third prerequisite for a successful early follower project is the existence of adequate course management software. The experience of the UB course team suggests that this prerequisite is close to being fulfilled. Many of the existing course management systems have been designed for use in small courses, where faculty or students enter much information by hand. What is needed is the easy integration of testing software from publishers, the ability to import grades from such software, more flexibility in the grading and grade reporting functions, and more flexibility in the file structures. What is hopeful is that while no single course management system currently has all of the necessary features, each required feature is available in at least one system. This suggests that the full functionality will be available soon in many systems.

4. Appropriate course specific software
   The final prerequisite is the existence of appropriate course specific software. For computer fluency courses there is a wide range of effective software, which enabled the UB course team to select the best materials for their specific course. In this area, much of the software is commercially available from textbook publishers. In other areas the software may be available from other faculty. The National Science Foundation and other organizations maintain web sites with pointers to freely available courseware [11]. While such software developed through NSF grants and other types of federal or foundation support is generally of outstanding quality, the maintenance and updating of such software can turn out to be too burdensome for the associated faculty to continue it's maintenance. Another alternative is to purchase software from one of the companies that have been spun-off from universities to provide on-line courseware and course supplementary materials.

### *Significance:*

The importance of this work goes beyond the effect on a single course at a single institution. This work can serve as a model for other early followers within the university as the course team members communicate their experiences to other faculty. It can also serve as a model for faculty at other institutions who wish to be early followers and create pedagogical usage of technology that is scalable. By demonstrating that technology enhanced courses can be created that don't require significant extra faculty time and significant additional infrastructure costs, the early follower model becomes a model that can be adapted by an increasing number of faculty members. In addition, working on restructuring courses with an increased use of new technologies, where both the pedagogical considerations and the costs of instruction are considered, creates a positive culture of change that can then spread to other aspects of the university.

### *References*


1. Robert Cavalier, Cases, Narratives, and Interactive Multimedia, Syllabus, 13(9):20-22, 2000.
2. Jack. M. Wilson, The CUPLE Physics Studio, NLII ViewPoint, 1(1), http://www.educause.edu/nlii/keydocs/viewpoints.html, 1996.
3. Math Emporium Web Site, http://www.math.vt.edu/temp/emporium_presentation/.
4. Nora Sabelli, Information Technologies, the Internet, and Education: No Longer a Luxury, Opening Presentation, Syllabus Puerto Rico Conference, May, 2000.
5. University at Buffalo iConnect @UB program, http://www.buffalo.edu/iconnect/.
6. Jeffrey R. Young, Invasion of the Laptops: More Colleges Adopt Mandatory Computing Programs, Chronicle of Higher Education 44(15):A33-A35, 1997.
7. Pew Learning and Technology Program, http://www.center.rpi.edu/PewHome.html.
8. UB CSE- Pew Collaboration, http://pew.cse.buffalo.edu/.
9. Committee on Information Technology Literacy, Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics, and Applications, National Research Council. Be FIT: Fluency in Information Technology, NATIONAL ACADEMY PRESS, Washington, D.C. 1999, http://www.nap.edu/readingroom/books/BeFIT/
10. Philip Davis, How Undergraduates Learn Computer Skills: Results of a Survey and Focus Group, T.H.E. Journal, 26(9):68-71, 1999.
11. National Science Foundation courseware website.

## Copyright Notice

EDUCAUSE *Information Resources Library*

Transforming Education Through Information Technologies

## Abstract

**Category:** Papers Presented at EDUCAUSE annual conferences

---

| | |
|---|---|
| **ID Number:** | EDU0004 |
| **Title:** | Early Followers versus Early Adopters: The Use of Technology as a Change Lever Leads to Increased Learning and Decreased Costs in a Computer Fluency Course |
| **Author:** | Carl Alphonce, Helene G. Kershner, Deborah Walters, Debra Burhans |
| **Organization:** | University at Buffalo |
| **Year:** | 2000 |
| **Abstract:** | Many early adopters of educational technology report increased costs, both in technology and in faculty time. This research shows how early followers can decrease costs by using existing on-line supplementary materials and a redesigned course structure that increases face-to-face contact and provides multiple means for students to learn course concepts. |

**This material is available in the following electronic formats:**

Select one of the icons above to retrieve the material in that format. We also have definitions and instructions for setting up your computer to download these formats.

---